



## C E R T I F I C A T E

I, Thomas Kitzhofer, of Rundfunkplatz 2, D-80335 München, Germany, declare that I am conversant with the German and English languages, and that to the best of my knowledge and belief the accompanying text is a true translation of the priority document issued by the German Patent and Trademark Office on 25 November 2003, for Serial No. 202 19 898.7.

Signed this 21st day of November 2006

A handwritten signature in black ink, appearing to read "Thomas Kitzhofer".

Certified Translation

**FEDERAL REPUBLIC OF GERMANY**

(coat of arms)

**Certificate of Priority Relating to the Filing  
of a Utility Model Application**

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**Applicant/Owner:** TRW Airbag Systems GmbH,  
Aschau a Inn/Germany

Original Applicant: TRW Airbag Systems GmbH & Co  
KG, Aschau a Inn/Germany

**Title:** Gas Generator

**IPC:** B 60 R 21/26

**The attached documents are a correct and true copy of the original  
documents of this utility model application.**

[seal of the  
German Patent  
and Trademark  
Office]

Munich, dated 25 November 2003  
**German Patent and Trademark Office**  
**The President**

By:

(signature)

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## Gas Generator

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The invention relates to a gas generator with a housing which has outflow openings for outflowing gas, and with at least one destructible insulation foil which in the non-activated state of the gas generator closes at least one outflow opening

5 so as to be moisture-tight, outflow openings being closed with insulation foil of varying thickness.

A generic gas generator is known from DE 38 31 641 A1. The insulation foil closes off the outflow openings over a period of years, so as not to allow any moisture to reach the solid propellant. By insulation foil of varying thickness, the 10 resistance of the insulation foil on opening can be adjusted and thereby the pressure inside the gas generator in the initial phase of combustion can be varied. The burning behavior is altered hereby. At high ambient temperatures of over 75°C up to 90°C, propellant burns substantially faster than at low ambient temperatures of, for example, below -25°C. In order to keep the burning speed more constant 15 over the entire temperature range of -40°C to 90°C, it is intended to keep some outflow openings closed at lower temperatures and thereby to increase the pressure inside the gas generator.

The invention provides a gas generator by which the fluctuations of the combustion chamber pressure in the above-mentioned temperature range are 20 reduced.

This is achieved in a gas generator of the type initially mentioned in that the varying thickness of the insulation foil or of the several insulation foils is brought about by at least one thermally insulating foil layer of varying thickness, which is applied on a base layer. In the gas generator according to the invention, the 5 insulation foil or the insulation foils is or are constructed having several layers. By means of the thermally insulating foil layer, it is achieved that the base layer lying under the foil layer and which is also a type of carrier layer, is heated more slowly and loses its strength more slowly. Thereby, the insulation foil in the region of its higher thickness is destroyed at least later than in the region of smaller thickness. 10 A destruction of the insulation foil in the region of higher thickness, however, does not have to necessarily take place, it is even possible for the insulation foil not to be destroyed at all in this region at low ambient temperatures, whereby the associated outflow opening remains closed.

Although according to the preferred embodiment, provision is made that an 15 insulation foil is used which covers several outflow openings or even all outflow openings and has a varying thickness in the corresponding regions for different outflow openings, it is also possible to use several insulation foils of varying thickness, in order to thereby achieve the above-mentioned purpose.

The thermally insulating foil layer can also be partially omitted, i.e. its thickness 20 can be zero. In this region, the base layer is then very quickly exposed to the generated heat and is also destroyed more quickly than in the region with the thermally insulating foil layer.

In this connection, the term "thermally insulating" means that the foil layer has a distinctly lower thermal conductivity than the base layer. The thermally insulating 25 layer is, in particular, a plastic layer, whereas the base layer is preferably of metal. The thermally insulating layer is to lie on that side of the insulation foil which faces the gas flow, in order to prevent a direct flow onto the base layer from this side.

Plastics have the characteristic that their strength decreases distinctly greater 30 with increasing temperature in the range of -40°C to 90°C, than is the case with metals. With an insulation of plastics, therefore, the static opening pressure will decrease in the temperature range of -40°C to 90°C. On activation of the gas generator, this effect is further intensified, because the greater intensity of the combustion reaction at 90°C heats the insulation foil more quickly than at -40°C. It is therefore highly efficient to coat the entire metallic base layer in order to lower 35 the opening pressure of the insulation foil with increasing temperature. The effect

becomes evident in Figure 3b at the maximums of the combustion chamber pressures at room temperature (RT) and 85°C. The maximum at room temperature even lies over that of 85°C.

It would therefore be conceivable for the base layer to be embedded between  
5 two thermally insulating foil layers, in order to delay a heating from both sides.

For reasons of manufacturing technique, the base layer is preferably constructed so as to have a uniform thickness.

A simple manufacture of the insulation foil can be achieved in that the thermally insulating layer is simply sprayed onto the base layer.

10 As already indicated, the insulation foil in a preferred embodiment only partially has the thermally insulating foil layer, in order to cover at least one selected outflow opening with the additional thermally insulating layer, and to cover at least one selected outflow opening with only the base layer.

15 At least one insulation foil should be coordinated with the output of the gas generator such that the generated gas exposes all outflow openings at an outside temperature of greater than 75°C, in particular about 85°C.

At low temperatures, i.e. at an outside temperature of less than -25°C, in particular less than -30°C, not all the outflow openings should be exposed, i.e. the insulation foil is not destroyed in these regions.

20 However, it can also be contemplated that even at low temperatures all the outflow openings or at least one outflow opening, which are closed by the thicker insulation foil, are opened. However, then it is possible by means of the insulation foil with a varying thickness, that a variable time delay can be set, until the associated outflow opening is opened. Here, the outflow opening or openings  
25 which are closed with a thicker insulation foil are to be exposed at an outside temperature of less than -25°C with a time delay, compared to the outflow opening with thin insulation foil, which is greater at least by a factor of four than the time delay which results at an outside temperature of greater than 75°C.

Further features and advantages of the invention will be apparent from the  
30 following description and the following drawings, to which reference is made and in which:

- Fig. 1 shows a cross-sectional view through an embodiment of the gas generator according to the invention,
- Fig. 2 shows an insulation foil which is able to be used in the gas generator according to the invention,

5        - Figures 3a and 3b show the combustion chamber pressure profiles and can pressure profiles of a gas generator equipped with a conventional insulation foil (Fig. 3a) compared to the combustion chamber pressure profiles and can pressure profiles in the gas generator according to the invention (Fig. 3b), and

- Fig. 4 shows a second embodiment of an insulation foil that can be used.

10      In Fig. 1 a gas generator 10 is illustrated, which has a housing 12, the housing 12 having walls which define the outer housing and the inner housing. The gas generator has a combustion chamber 14 which is filled with solid propellant 16. The solid propellant 16 can be ignited by an igniter 18. A section of the housing 12 defines the combustion chamber 14; this section is named the combustion 15 chamber wall 20. The combustion chamber wall 20 has on its periphery several uniformly distributed outflow openings 22, which preferably all have the same diameter. An insulation foil 24, which closes all the outflow openings 22, is glued onto the inner side of the combustion chamber wall.

The housing 12 has in addition an outer wall 26 which is likewise provided with 20 outflow openings 28. On the inner side of the outer wall 26, an insulation foil 24 can likewise be provided, this insulation foil 24 being provided additionally or alternatively to the insulation foil 24 lying on the inner side of the combustion chamber wall 20. The insulation foil 24 prevents the entry of moisture into the combustion chamber 20.

25      In Fig. 2 the insulation foil 24 is illustrated in spread-out state. The insulation foil 24 consists of several layers, namely a base layer 32 of metal having a large area, and a thermally insulating foil layer 34 of plastic applied onto the base layer, which is applied onto the base layer 32 by spraying. As can be seen from Fig. 2, the foil layer 34 is, however, only partially applied onto the base layer 32. The illustrated 30 holes 36 symbolize the positions of the outflow openings 22 which are closed by the insulation foil 24. The base layer 32 and the foil layer 34 each have a uniform thickness across their extent, so that the entire insulation foil 24 has the greatest thickness in the region of the foil layer 34. The insulation foil 24 is fastened to the

combustion chamber wall 20 such that the foil layer 34 directly faces the solid propellant 16.

After the igniting of the solid propellant 16, the latter is burned and hot gas is produced in the combustion chamber 14, which strikes directly onto the base layer 5 32 or, where present, onto the foil layer 34. The heat development combined with the pressure development provides for a local destruction of the insulation foil 24 in the region of the outflow openings 22.

The individual layers of the insulation foil 24 are constructed here such that at an ambient temperature of the gas generator (temperature of the gas generator 10 before ignition) of greater than 75°C, in particular of approximately 85°C, all the outflow openings 22 are opened, i.e. also the foil layer 34 is destroyed.

At low outside temperatures of less than -25°C, in particular less than -30°C, the foil layer 34 insulates the section of the base layer 32 lying under it, so that the insulation foil 24 in this region is either not destroyed at all and the associated 15 outflow openings 22 thereby remain closed, or these outflow openings would be opened with a distinctly greater time delay compared to the outflow openings 22 covered only by the base layer 32 than is the case with an outside temperature of greater than 75°C. The time delay here should be greater by at least a factor of four than the time delay which occurs at the outside temperature of greater than 20 75°C.

In Figure 4, the construction of a second insulation foil 124 is shown, which has a metallic base layer 32 which in three regions has insulation foils of varying thickness applied thereon. Figure 3b shows the corresponding combustion chamber and can pressure curves with this coated insulation compared to a 25 generator with uniformly thick metal foil as insulation (Figure 3a).

The six larger openings 122 are covered with the thinnest foil layer section 134 and open in the entire temperature range of -40°C to +90°C. At 85°C, in addition all the more intensively covered eight smaller openings 124 and 126 will open. At 23°C, only the four smaller openings 124 are opened, in the region 136 of which 30 the foil layer has a medium thickness. The bores 126 in a region 138, in which the foil layer has the greatest thickness, remain closed at 23°C.

Through a corresponding graduation of the layer thickness of the foil layer over all the small openings 124, 126, also even a refinement of the opening behavior over the entire temperature range would be possible.

Figures 3a and 3b show a comparison of a gas generator with a uniformly thick metal foil as insulation (Figure 4a) and with the use of the insulation according to Figure 4. The combustion chamber pressure and also the so-called can pressure are illustrated. The can pressure is the pressure inside a metal container of 5 standardized size, in which the gas generator is ignited in the laboratory, and with which the pressure inside a gas bag is simulated. With the aid of the comparison of Figures 3a and 3b, it becomes clear that in the gas generator according to the invention, the combustion chamber pressure profile depends less on the outside temperature than in a conventional one. Furthermore, the can pressure also varies 10 less over the temperature range than with a uniformly thick insulation foil. In order to keep the combustion chamber pressure at 85°C as low as possible, the housing provided with the insulation foil according to the invention should have a large outflow area which can be larger than in the gas generator the pressure profile of which can be seen in Figure 3a.

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Claims

1. A gas generator, comprising  
a housing (12), which has outflow openings (22, 28) for outflowing gas, and  
at least one destructible insulation foil (24) which in the non-activated state of  
5 the gas generator (10) closes at least one outflow opening (22) so as to be  
moisture-tight,  
outflow openings (22) being closed with insulation foil (24) of varying thickness,  
characterized in that  
the varying thickness is provided by at least one thermally insulating foil layer  
10 (34) of varying thickness, which lies over a base layer (32).
2. The gas generator according to Claim 1, characterized in that the thermally  
insulating foil layer (34) is a plastic layer.
3. The gas generator according to any of the preceding claims, characterized  
in that the thermally insulating foil layer (34) lies on the side of the insulation foil  
15 (24) which faces the gas flow.
4. The gas generator according to any of the preceding claims, characterized  
in that the base layer (32) is made of metal.
5. The gas generator according to any of the preceding claims, characterized  
in that the base layer (32) has a uniform thickness.
- 20 6. The gas generator according to any of the preceding claims, characterized  
in that the thermally insulating foil layer (34) is applied onto the base layer (32) by  
spraying.
7. The gas generator according to any of the preceding claims, characterized  
in that an insulation foil (24) is provided which covers several outflow openings (22)  
25 and has regions of different thickness for different outflow openings (22).
8. The gas generator according to any of the preceding claims, characterized  
in that the thickness of the thermally insulating foil layer (34) is, in parts, zero.
9. The gas generator according to Claim 8, characterized in that the insulation  
foil (24) only partially has the thermally insulating foil layer (34), in order to cover at

least one selected outflow opening (22) with the additionally thermally insulating foil layer (34) and to cover at least one selected outflow opening (22) with the base layer (32), without the foil layer (34).

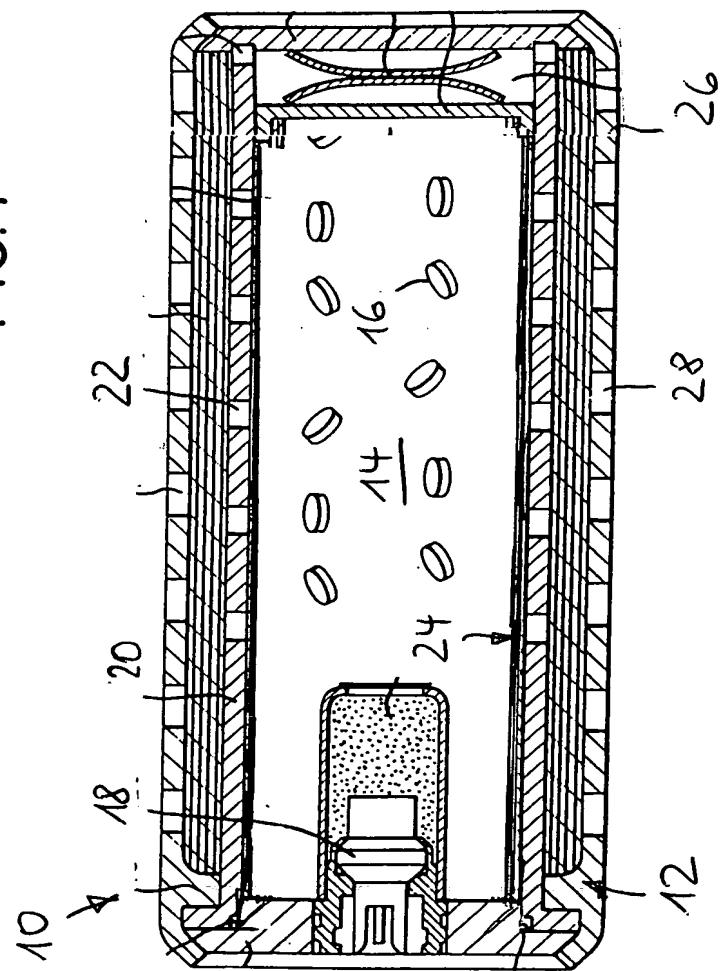
10. The gas generator according to any of Claims 1 to 7, characterized in that  
5 the base layer (32) is covered on the front and rear sides by the foil layer (24).

11. The gas generator according to any of the preceding claims, characterized in that the at least one insulation foil (24) is constructed such that at an outside temperature of greater than 75°C, in particular approximately 85°C, the generated gas opens all outflow openings (22).

10 12. The gas generator according to any of the preceding claims, characterized in that the at least one insulation foil (24) is constructed such that at an outside temperature of less than -25°C, in particular less than -30°C, the generated gas does not open all outflow openings (22).

13. The gas generator according to Claim 11, characterized in that the at least  
15 one insulation foil (24) is constructed such that at an outside temperature of less than -25°C, the outflow opening (22) which is closed by a thicker insulation foil (24), compared with the outflow opening (22) which is closed by a thinner insulation foil (24), is opened with a time delay which is greater by at least a factor of four than the time delay which results at an outside temperature of greater than 75°C, in  
20 particular approximately 85°C.

FIG. 1



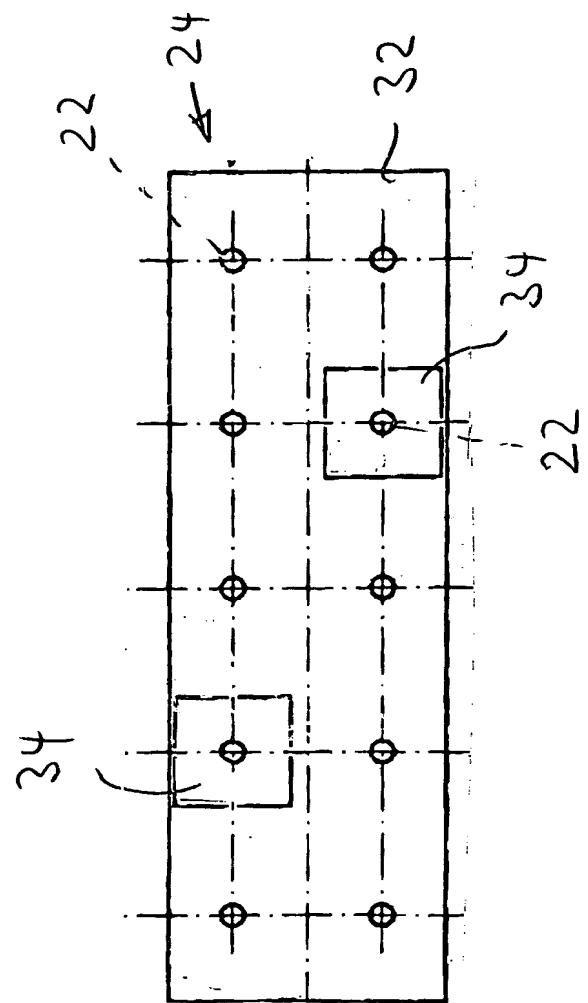


Fig. 2

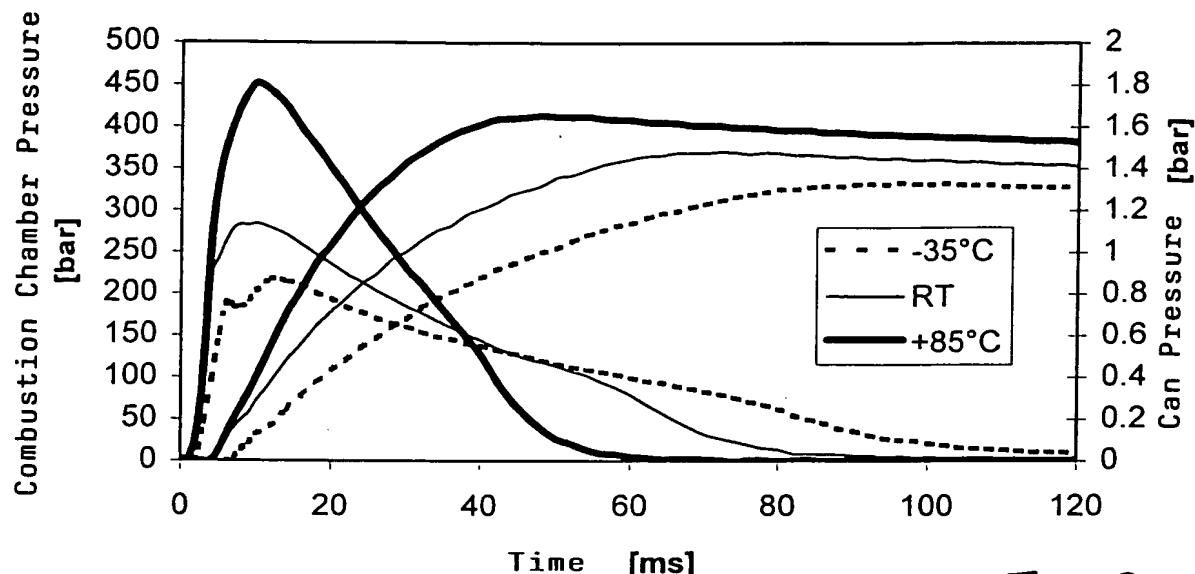


Fig. 3a

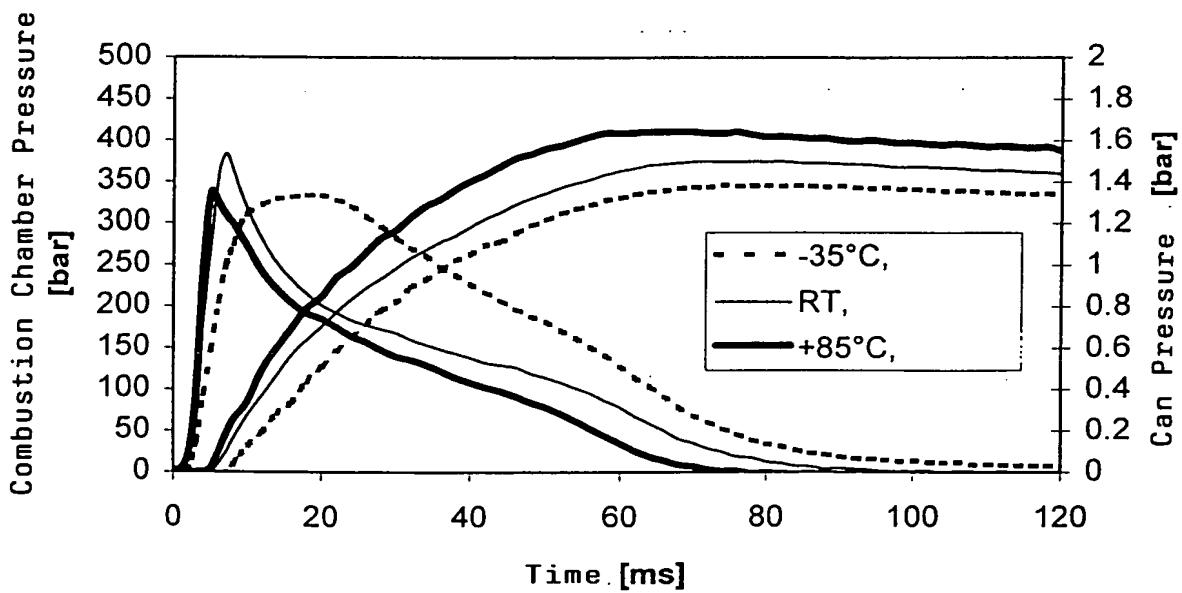


Fig. 3b

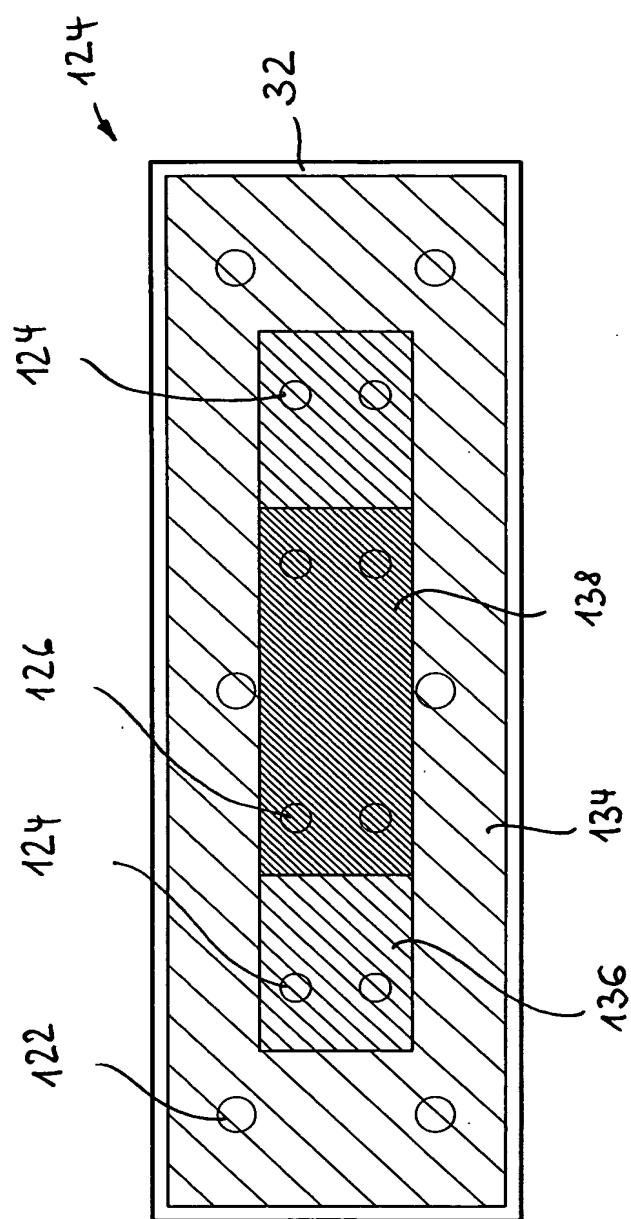


Fig. 4